The Optical Properties of Crystals with a general introduction to their physical properties, being selected parts of the Physical Crystallography. By P. GROTH, Professor of Mineralogy and Crystallography in the University of Munich. Translated (with the author's permission) from the fourth revised and augmented German edition by B. H. JACKSON, M.E., M.A., of the University of Colorado. 8vo, xiv + 309 pages, with 121 figures in the text and two colored plates. Cloth, $3.50. New York, John Wiley & Sons; London, Chapman & Hall, Limited. 1910.

This is a partial translation of the well-known work of Professor von Groth, "Physikalische Krystallographie," which is generally regarded by those who have to deal with optical crystallography as the best non-mathematical treatise on this subject yet produced. The translation, to quote from the translator's prefatory note, "is made up chiefly of matter contained in Part I. of the original work, on the properties of crystals; besides embracing the general introduction and all that falls under the heading optical properties in this part, it includes also whatever may be found there on the influence of other properties on the optical properties. Short extracts from Parts II. (Systematic Description of Crystals) and III. (The Methods of Crystal Investigation) have been introduced, on occasion, for illustration and example."

The scope of the work may be gathered from the headings of the principal divisions which are as follows: General Introduction to the Properties of Crystals; The Nature of Light; Combination (Interference) of Plane-polarized Light; Optically Isotropic Bodies; Double Refraction of Light; Optically Uniaxial Crystals; Optically Biaxial Crystals; Recapitulation: Classification of Crystals According to their Optical Properties; Combinations of Doubly Refracting Crystals to show the Character of their Double Refraction; Rotation of the Plane of Polarization of Light in Crystals; Absorption of Light in Crystals; Influence of other Properties on the Optical Properties of Crystals including Thermal Properties, Elastic Strain by Mechanical Forces and by Electrical Forces, Permanent Strain, and Twinning.

The translation is excellent, the English being free and idiomatic but following closely the original text. The work is entirely within the comprehension of any student who knows the rudiments of crystallography and forms a much-needed and very welcome addition to the English text-books in the field covered by it.

The colored plates reproduced from the original work are excellent; I comprises a spectrum of white light and a Newtonian color scale of the first four orders; II presents the important types of interference figures in convergent light in thirteen figures.

An appendix contains a useful list of German and American supply houses for apparatus, models, crystals and preparations. English firms might well have been added to this list.

CHARLES PALACHE

SPECIAL ARTICLES

WEST ELIZABETH, PENNSYLVANIA, DEEP WELL[1]

I AM indebted to Dr. I. C. White,[2] state geologist of West Virginia, for calling my attention to the omission from my paper published in SCIENCE, May 26, 1911, under the title "Underground Temperatures," of an important deep boring made in 1897 in Allegheny County, Pa. The data relating to this well are so important as to be worthy of a separate note.

The well is located on Peter's Creek about two and one half miles west of West Elizabeth, Allegheny County, Pa., and about twelve miles south-southeast of Pittsburgh. It is the deepest well drilled in the United States

[1] White, I. C., West Virginia Geological Survey, Vol. I(A), 1904, pp. 103–107. Hallock, W., "Subterranean Temperatures at Wheeling, W. Va., and Pittsburg, Pa.," *School of Mines Quarterly*, 1897, Vol. XVIII., pp. 148–153; see especially pp. 151–153.

[2] Personal communication, June 6, 1911.

and was put down by the Forest Oil Company in 1897. The well was dedicated to science and had for its purpose drilling down and into the Corniferous limestone, but after a depth of 5,575 feet was reached an accident beyond repair occurred and further drilling was from necessity abandoned. The well was begun 130 feet below the Pittsburgh coal, and after passing through rocks of the Carboniferous (Pennsylvanian and Mississippian) and of the Upper and most of the Middle Devonian, was bottomed (5,575 feet) in supposed Marcellus black shale, probably not more than 100 feet above the Corniferous limestone. The vast thickness of rocks penetrated by the well were all sedimentaries, including, according to the log,[3] shales, slates, coal, sandstones and limestones, as the chief lithologic types.

At the request of Dr. White, Professor William Hallock, of Columbia University, was afforded every facility for measuring the temperature of the well. A brief statement of the temperatures measured in the well was published by Professor Hallock in 1897.[4] Five measurements made at different depths are recorded by Dr. White. These may be tabulated as follows:[5]

TEMPERATURE MEASUREMENTS IN WEST ELIZABETH DEEP WELL

Temperature at		Difference in temperature for		Kind of rock
525 ft.	57° F.			Sand.
2,252 ft.	64	1,677 ft.	7° F.	Slate
2,397 ft.	78	445 ft.	14	Slate and shells.
5,010 ft.	120	2,613 ft.	42	Limestone.
5,380 ft.	127	370 ft.	7	Slate.

The figures in the table above explain themselves and need no comment except that the increment of heat is shown to be exceedingly variable, and is in accord with many other deep wells over the earth's surface in which temperature measurements have been made. The explanation offered for the variation in temperature shown in this well is the presence of a considerable flow of natural gas from the Bayard sand at 2,282–7 feet.[6] The average increment of heat for a depth of 4,855 feet, which represents the difference between the least (525 feet) and the greatest (5,380 feet) depths at which temperature measurements were made, is 1° F. for every 69.3[7] feet.

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[3] A complete log of the well is published by Dr. White in Volume I(A) of the West Virginia Geological Survey, 1904, pp. 104–107.

[4] Hallock, W., *School of Mines Quarterly*, 1897, pp. 151–153.

[5] Data taken from Vol. I(A) of West Virginia Geological Survey, 1904, pp. 104–107.

[6] Professor Hallock states that "the thermometers at 2,250 feet indicated a cooling due to the expansion of the gas amounting to about 14°." *Op. cit.*, p. 153. Gas, volume 25 lbs. per min., West Virginia Geol. Survey, Vol. I(A), p. 105.

[7] Professor Hallock gives the increment of heat from top to bottom (5,000 feet) of well as 1° F. for 71.5 feet. *Op. cit.*, p. 150, table II.

ADDITIONAL NOTE ON RETICULATED FISH-SCALES

SINCE the publication of my recent account of dipnoan fish scales in SCIENCE, some interesting facts have come to light.

1. Dr. L. Hussakof, of the American Museum of Natural History, has very kindly placed in my hands scales of *Sagenodus* from the Carboniferous rocks of Mazon Creek, Illinois. A well-developed scale is oval, about 50 mm. long and 37 broad, and in appearance and structure essentially agrees with the scale of the living (Australian) *Neoceratodus*. The reticulations are evident, and the very fine basal longitudinal fibrillæ are minutely tuberculate. Thus we have positive evidence of the enormous antiquity of this type of scale, including even the details of structure.

2. A specimen of the sucker *Moxostoma cervinum* Cope, collected by Dr. B. W. Evermann, proves to have two kinds of scales. One has a quadrate form, with strong laterobasal angles, strong apical and basal radii, the circuli dense in the basal and lateral fields, but widely spaced in the apical. This is the sort of scale we are accustomed to find in *Moxostoma*, a scale strongly suggestive of various old-world cyprinids. The other type of scale has the laterobasal angles more rounded, radial lines running to the margin